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ABSTRACT

A series of five experiments tested the importance of four types of skill development (single-word decoding, vocabulary knowledge, knowledge of text schemas, and question-answering skills) for reading comprehension improvement. In two of three experiments involving undergraduates with no known reading problems, results indicated that teaching text schemas and providing question-answering practice led to significant improvement in reading comprehension. There were 24 subjects in experiment 1, 20 subjects in experiment 2, and 30 subjects in experiment 3. Subjects who received decoding and vocabulary practice improved on those tasks but did not improve on reading comprehension. All subjects received three hours of individualized practice. When schema and test-taking practice were provide in small-group settings, in a third experiment, subjects' reading comprehension did not benefit. In two additional experiments replicating experiments 1 and 3, schema and question-answering practice failed to bring about improved reading comprehension in subjects who had failed a reading competency exam for students entering the university. Failure to bring about reading comprehension improvement in these subjects was not because the materials were too difficult. Findings suggest that textual knowledge-based skills, sharpened through the development of text schemas and question-answering skills, increased reading comprehension performance, but not for all subpopulations of college students. (Contains 14 references and a figure illustrating templates for schema instruction.) (RS)

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Reading Comprehension Development: Increasing Processing Capacity Versus Increasing Knowledge

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Summary Of The Major Goals And Findings Of This Research

In a series of five experiments conducted over the past two years with college undergraduates, our primary emphasis has been on reading comprehension improvement. We adopted a model of reading that broke it down into subcomponent processes, and then we tested the importance of four types of skill development to reading comprehension improvement. The four types of skill development involved single-word decoding, vocabulary knowledge, knowledge of text schemas, and question-answering skills. In two of three experiments, described in detail later, that were conducted with undergraduates with no known reading problems, we found that teaching text schemas and providing question-answering practice resulted in significant improvement in reading comprehension. Subjects who received decoding and vocabulary practice improved on those tasks but did not improve on reading comprehension. All subjects received 3 hours of individualized practice. When schema and test-taking practice were provided in small-group settings, in a third experiment, subjects' reading comprehension did not benefit. In two additional experiments, briefly described at the end, schema and question-answering practice failed to bring about improved reading comprehension in subjects who, prior to participating in our experiments, had failed a reading competency exam for students entering the university. We established that our failure to bring about reading comprehension improvement in these subjects was not because the materials were too difficult. We hypothesized that these students had simply not received enough practice in the schema and question-answering conditions. Currently, we are conducting an experiment with students from this subpopulation in which they will receive approximately 15 hours of practice, which is a fivefold increase compared to the earlier studies.

Theoretical Background For Our Research Program

Reading for understanding is a demanding task. It places demands on the reader in two ways. First, it uses physical and cognitive resources. Text is input in a left-to-right manner under the control of the reader, who must encode the individual words and attend to various cues, like function words and punctuation, and information in both foveal and parafoveal view, in order to construct and maintain an internal representation of the text. This is demanding because visual receptors and cognitive representations in memory require time for activation. Activation of new information occurs at the same time that old information is decaying. Various processing subsystems, like working memory, place severe limits on the amount of information that can be maintained and introduce requirements for memory rehearsal and regressive eye movements lest information be lost (Baddeley, 1986; Just & Carpenter, 1987).

A basic question that needs to be addressed is what specific instruction will improve reading comprehension. According to Perfetti and colleagues (Perfetti, 1985; Perfetti & Lesgold, 1977, 1979; Perfetti & Hogaboam, 1975) improving any component related to reading should make a difference because the reading system as a whole shares limited processing resources. More specifically, Perfetti and Lesgold (1979) suggest that skilled reading depends on three component processes: i) fast, automatic decoding, ii) access to word meanings and conceptual structures in long-term memory, and iii) processing strategies for

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organizing sentences into meaningful chunks. These processes are not functionally independent (Perfetti & Lesgold, 1979). In terms of importance, Perfetti and colleagues place the most importance on i, less on ii, and little on iii.[1] According to these researchers, a bottleneck exists in the decoding component, and to a lesser extent, in lexical access to word meanings. Making these processes more automatic frees up processing resources for text-level operations, which include making inferences about the text and answering questions about the text. The emphasis that Perfetti and colleagues place on decoding and vocabulary knowledge motivated two of the conditions in our experiments.

Not everyone has emphasized decoding and vocabulary as the primary bottlenecks in comprehension. Instead, emphasis has been placed on metacognitive knowledge and strategies, like generating questions about the text before reading it and then finding answers to those questions in the course of reading (Singer, 1978), or actively monitoring for comprehension and implementing "fix up" strategies when comprehension breaks down (Wagoner, 1983). In our experiments we chose to focus on text-level factors based on the work of Samuels and colleagues (Samuels, 1989; Samuels, Tennyson, Sax, Mulcahy, Schermer, & Hajovy, 1988). According to these researchers, readers and writers have expectations about text structure. To the extent that readers' expectations are met, comprehension benefits (Samuels, 1989; Samuels et al., 1988). In one condition, we directly taught text schemas for short passages to subjects. In another condition, we allowed subjects to develop their own text schemas by giving them practice answering questions on comprehension tests.

Three Experiments With College Students In Good Academic Standing

Subjects, Materials, and Procedures

In the three experiments summarized here, subjects were college undergraduates enrolled in psychology courses, who participated in the experiments for extra credit points. There were 24 subjects in Experiment 1, 20 subjects in Experiment 2, and 30 subjects in Experiment 3. Subjects were randomly assigned in equal numbers to the conditions in those experiments, under the constraint that the mean performance on the pretest be similar across the experimental conditions.

All subjects participated for 5 consecutive days for approximately one hour each day. On the first day, they took a pretest that provided the initial measure of reading comprehension performance, and on the last day they took a posttest that provided a measure of the effectiveness of the practice that they received during the three intervening days. Subjects received practice either decoding words (Experiment 1), learning and practicing vocabulary (Experiment 1), learning text schemas (Experiments 1-3), or answering typical comprehension questions (Experiments 1-3).

The reading passages that were used for the pretest and posttest and for practice in the schema and question conditions were taken directly from 10 SATs (College Entrance Examination Board, 1990), a book of exercises for preparing for the Scholastic Aptitude Test.[2] Eight of these passages were divided into two sets and were used for the pretests and posttest. Each set contained 14 multiple-choice questions that were used to measure reading comprehension. The passages were assigned to a schema category based on their content, contingent upon the mutual agreement of the three experimenters. Set A contained two examples of technical and narrative passages and Set B contained two examples of historical and commentary passages. Reading difficulty for each passage was established using the Fry Readability Scale. Both sets of passages had a mean difficulty rating just below the 12th grade level (Set A = 11.75; Set B = 11.50), and both sets ranged in difficulty from the 10th to the 13th grade level. Additional passages similar to the test passages were selected for practice in

[1] Beck, Perfetti, and McKeown (1982) provide additional support for the role of vocabulary knowledge.

[2] These passages were reprinted by permission of Educational Testing Service, the copyright owner.

the question condition and in the schema condition (For schema practice, the passages were used without the comprehension questions). One-half of the subjects received Set A for their pretest and Set B for their posttest and one-half received the converse sets, according to random assignment. If subjects were pretested using Set A, then they received practice relevant to material on the Set B posttest, and vice versa.

In order to make decoding and vocabulary practice meaningful in the context of the present study, we selected low-frequency words whose meanings were likely to be unknown to most subjects (e.g. mestizos, pterosaur) and that appeared in the passages that were used for the posttest. The templates that were used in schema training are presented in Figure 1. As is evident in Figure 1, each template outlines the information that is inherent in a particular type of passage, the relative location of pieces of information, and the relationship to other relevant information. For example, the slots connected hierarchically with arrows represent the ordering of information contained within a particular type of passage. The information connected peripherally represents additional information that may or may not be present at that particular location in the passage.

The practice materials for word decoding and definitions were presented on a CompuAdd 286 personal computer interfaced with a timer accurate to 1 millisecond. Practice trials began with the presentation of a fixation mark in the center of the screen. Subjects initiated a trial by depressing the spacebar on the keyboard, which started the timer. They either read the word on the screen aloud or defined the word. A microphone interfaced with the computer detected vocalization onset and stopped the timer. The computer recorded onset latencies automatically; the experimenter recorded errors by hand. Training on schemas and training in the Question condition were paper-and-pencil manipulations. Schema subjects learned the schema components of practice passages that were similar to the posttest (but without the comprehension questions) and of the same schema types as those that would appear on the posttest. Subjects in the Question condition were given practice using passages that were similar to the posttest and of the same schema types as those that would appear on the posttest (technical and narrative, or historical and commentary). Subjects completed one passage at a time and were given feedback by the experimenter on the accuracy of their responses.

Results For Experiment 1

Subjects were significantly faster and more accurate in decoding and defining words across successive days of practice, based on one-way analyses of variance for each condition (Error rates Decoding: F (2, 10) = 7.88, $p < .01$; Vocabulary: F (2, 10) = 14.79, $p < .001$; Schema vocabulary training: F (1, 5) = 51.49, $p < .001$; Vocalization latencies Decoding: F (2, 10) = 7.35, $p < .05$; Vocabulary: F (2, 10) = 15.94, $p < .001$; Schema vocabulary training: F (1, 5) = 69.55, $p < .001$). Subjects gained knowledge of schemas through schema training, F (1, 5) = 31.24, $p < .01$, as indicated by their increased ability to complete the parts of the schemas on the schema test, which was administered on the third day of practice. Evidence for learning in the question condition, based on performance on the practice materials, F (2, 10) = 3.20, $.05 < p < .10$, is more difficult to assess because there was no control over the difficulty of the materials from day to day. In general, the results suggested that subcomponent skills related to reading comprehension had improved and that the training had been successful.

A 2 (Test: Pretest, Posttest) X 4 (Condition: Decoding, Vocabulary, Schema, Question) analysis of covariance, using subjects' comprehension scores on the pretest and posttest as the dependent measure and pretest and posttest times as the covariate, indicated that test time was not a significant covariate (F (1, 19) = 1.70, ns), thus we conducted the analysis without this covariate. The main effect for Test was significant, F (1, 20) = 13.08, $p < .003$, but not for Condition, F (3, 20) = 1.82, ns. The interaction effect was marginally significant, F (3, 20) = 2.55, $.05 < p < .10$, suggesting differences between the conditions.

Planned comparisons using one-df F-tests revealed that performance increased on the posttest relative to the pretest, but only for those

who received Schema practice, F (1, 5) = 16.04, $p < .01$, and Question practice, F (1, 5) = 6.67, $p < .05$. An additional comparison comparing the relative importance of schema versus question practice using difference scores (i.e. posttest score minus pretest score) indicated that the schema practice (mean difference = 2.83) was not significantly different from question practice (mean difference = 2.00), F (1, 10) < 1.

Conclusions From Experiment 1

At the outset we assumed that cognitive systems are limited-capacity processors and, more specifically, that component processes in reading must share limited processing resources. Perfetti and colleagues (Perfetti, 1986; Perfetti &Hogaboam, 1975; Perfetti & Lesgold, 1977, 1979) hypothesized that making any subcomponent of reading more automatic would free up resources for other reading processes. For them, the most important subcomponents were decoding and vocabulary knowledge. Carrying through their reasoning, an improvement in either one or both of these processes should have made scarce processing resources more available to text-level processes, thereby contributing to improved comprehension performance. In this experiment, we demonstrated significant improvement in decoding and vocabulary performance, but we failed to find evidence that comprehension improved. In the vocabulary condition, there was no difference in the mean performance on the comprehension pretest compared to the posttest (mean = 9.00). In the decoding condition, there was a small improvement from the pretest (mean = 6.33) to the posttest (mean = 7.17), but it was not statistically reliable. Thus, these results failed to support the more general hypothesis proposed by Perfetti and colleagues that improvement anywhere in the reading system would result in higher comprehension (as measured by standard test questions). The results also failed to support their specific claim that the bottleneck to comprehension existed in the decoding and vocabulary subcomponents.

A major thread in our thinking and in cognitive psychology in general (e.g. Simon, 1990) draws on the notion of scarce processing resources. A fundamental goal of individuals in diverse domains is to learn how to work within the limits imposed by the "hardware" of the cognitive system, but also to constantly strive to overcome those limitations through learning and practice. Is this the right explanation for the observed improvement in the schema and question conditions? Addressed from the perspective of "scarce resources," a positive response would entail that individuals in these conditions made comprehension processes more automatic. Automaticity implies fast, effortless processing (e.g. Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977). The next experiment tests this possibility. If the "scarce resources" explanation is the correct one for the advantage that we found in the schema and question conditions, then eliminating the emphasis on speeded processing in those conditions should eliminate or at least weaken the advantage that we observed in those conditions. Thus, in the next experiment we were interested in how practice with schemas or questions fostered reading comprehension in the absence of speeded practice. The procedure for testing and for practice was identical to Experiment 1, except that no emphasis was placed on speeded performance.

Results & Conclusions: Experiment 2

A 2 (Test: Pretest, Posttest) X 2 (Condition: Schema, Question) analysis of covariance, using comprehension test scores as the dependent measure and test times as the covariate indicated that test time was not significantly related to Condition, F (1, 13) = 2.89, $p > .10$, but it was significantly correlated with Test, F (1, 13) = 4.87, $p < .05$. Subjects took 18.4 minutes for the pretest and 20.1 minutes for the posttest, on average. In the covariate analysis, Condition and the Condition X Test interaction were not significant, F's < 1. The effect of Test was marginally significant, F (1, 13) = 3.46, $p \leq .09$ ($p < .05$ on a unidirectional test). An analysis without the covariate showed comparable effects for Condition and the Condition X Test interaction, F's < 1, but a significant effect for Test, F (1, 14) = 6.06, $p < .03$. The mean pretest and

posttest scores in the the question condition were 7.00 and 8.75, respectively; and in the schema condition they were 8.25 and 9.38.

Two results from this study confirmed that knowledge-based factors, not the release of "scarce resources" per se, were responsible for the observed increase in reading comprehension performance. First, processes are automatized and functional processing capacity is increased when operations become fast and automatic. The positive correlation between test time and comprehension scores, and the longer posttest versus pretest times, are contrary to an automaticity interpretation. The effect of practice was to slow performance down. With time as a covariate, there was no apparent effect of practicing schemas or questions. When we eliminated time as a covariate we found a strong effect for posttest versus pretest performance.

The second finding that supports the importance of knowledge-based factors is directly related to the experimental manipulation, which did not emphasize speed of processing during practice or testing. If task improvement depends solely on making some processes more automatic in order to free up scarce processing resources, then an experimental manipulation that did not emphasize speed and an experimental outcome that involved slower processing, should not have resulted in improved task performance. The fact that both of these were associated with improved posttest performance argues for an alternative explanation based on knowledge.

Although fast, effortless processing is often a sign of well-learned, highly-practiced performance, our findings suggest that speed cannot always be taken as a measure of learning or a predictor of performance. When no emphasis was placed on speed, subjects slowed down but also got better. Assuming that the practice sessions helped subjects learn about text structure and that subjects used that knowledge on the posttest, longer times on the posttest reflected the extra time that it took subjects to apply their new knowledge. This view is consistent with observations in Samuels (1988) who suggested that poor readers read passively rather than becoming actively engaged. "They read as though their task were to get to the end of the text regardless of whether they understood what they have read" (p. 3). We believe that are subjects were less inclined to read passively after their practice meetings. One consequence was that they took longer as they processed the text more fully. Importantly, they did better on the posttest. We could argue that the new knowledge used up more processing resources to execute, and in this light, the improved performance was not due to freeing up scarce processing resources but to new knowledge structures. The non-significant interaction in our statistical analysis suggested that both the schema and question conditions allowed subjects to acquire useful knowledge structures.

In the final experiment we were interested in determining whether the same benefit from practice could be achieved in small groups. This issue is not directly related to the cognitive processing issues that we have been pursuing to this point, but it is relevant to applying our findings to instructional settings where, usually, individual instruction cannot be provided. The procedure and materials were identical to Experiment 2, except that subjects met in groups of 4-5 instead of individually with the experimenter.

Results & Conclusions: Experiment 3

Subjects in all conditions tended to take longer and do worse on the posttest compared to the pretest, although not significantly so. A 2 (Test: Pretest, Posttest) X 2 (Condition: Schema, Question) analysis of covariance, using comprehension test scores as the dependent measure and test times as the covariate indicated that time was not a significant covariate ($F < 1$), thus we reanalyzed the data without this covariate. Neither the main effects nor the interaction were significant (all F's < 1).

It is not clear why subjects did not benefit from schema and question practice when placed in a group setting, however, some suggestions do come to mind. When training subjects in small groups, it was more difficult for the experimenter to monitor comprehension performance of all subjects in real time, without reverting to training subjects on an individual basis. Many of the subjects may have failed to

grasp some of the intricacies of the questions that they were practicing, and some subjects tended to work at a slower pace than others. That is, the experimenter was unable to tailor practice to each person's ability.

Our inability to bring about improved comprehension in a small group setting can be framed from a slightly different perspective by noting that in the current research we were interested in experimental manipulations that would bring about significant improvement in comprehension with practice occurring over relatively short durations. Typical group settings, i.e. classrooms, operate on much longer time frames. Thus, the advantage that we found for schema and question practice may apply to ordinary classrooms as well as the psychological laboratory. However, in a classroom setting, reading comprehension improvement may emerge over a longer time period.

Two Experiments With College Students That Failed A University-Administered Reading Competency Exam For Incoming Students And A Description Of An Ongoing Study

Our primary interest in conducting this line of research has been in remediating students at our university (incoming freshmen) that failed the university administered reading competency exam. For the most part, the exam tests students using passages and comprehension questions similar to those that we used in the experiments described above. In a replication of Experiments 1 and 3, we failed to find any improvement in reading comprehension as measured by our standard pretest to posttest comparison. Subjects who were given decoding and vocabulary practice showed significant improvement in their performance of these tasks, suggesting that subjects were learning during the practice meetings. We also determined that subjects were performing at a level significantly above chance on the pretest and posttest, indicating that the materials were not too difficult for them.

This pattern of results is indeed puzzling. Currently, we are replicating a version of Experiment 2 with subjects from this subpopulation. The major difference is that subjects in the current experiment are receiving 5 times as much practice - 15 hours instead of 3. We hypothesize that these subjects can benefit from schema and question-answering practice but simply require more of it for it to be effective.

Significance To The Field Of Developmental Education

These experiments provide some insight into the "scarce resources" and knowledge-based views of cognitive processing, as these apply to reading comprehension. One cannot make the generalization that automatizing any component in the reading system will free up limited processing resources and thereby result in better performance elsewhere in the system. Our experimental manipulations produced an apparent dissociation of processing within the reading system. Practice increased skill in word decoding and word definitions but failed to improve comprehension, whereas practice in skills directly useful to text processing did improve comprehension. For the schema and question conditions, there was no evidence that emphasizing speed was important during practice. The major influence appears to be from the deeper knowledge of the underlying text organization gained by subjects in these conditions.

We also found that schema practice and question practice were equally effective in bringing about significant improvement in comprehension. Future research should strive to determine whether the two groups acquired different cognitive representations through practice or whether both types of practice resulted in a form of knowledge common to the two groups.

Our findings bear directly on current methods of reading instruction, particularly for early adult readers confronted with the prospect of passing competency tests or college entrance exams. Textual knowledge-based skills, sharpened through the development of text schemas and question-answering skills, were shown to increase reading comprehension performance, but not for all subpopulations of college students that we tested. Schema-based and test-specific instructional methods, when

applied to a classroom setting, have the potential to foster text comprehension, particularly for young adult readers. The question remains as to the generality of our results. If these instructional methods can be demonstrated to be effective for a wide range of student abilities and under diverse instructional conditions, they should be exploited by educators and researchers alike.

References

Baddeley, A. (1986). Working memory. Oxford: Oxford University Press.

Beck, I., Perfetti, C., & McKeown, M. (1982). Effects of long-term vocabulary instruction on lexical access and reading comprehension. Journal of Educational Psychology, 74, 506 521.

Just, M., & Carpenter, P. (1987). The psychology of reading and language comprehension.Boston: Allyn and Bacon, Inc.

Perfetti, C. (1985). Reading ability. New York: Oxford University Press.

Perfetti, C., & Hogaboam, T. (1975). Relationship between single word decoding and reading comprehension skill. Journal of Educational Psychology, 67, 461-469.

Perfetti, C., & Lesgold, A. (1979). Coding and comprehension in skilled reading and implications for reading instruction. In L. Resnick and P. Weaver (Eds.), Theory and practice of early reading, Vol. 1 (pp. 57-84). Hillsdale, NJ: Lawrence Erlbaum Associates.

Perfetti, C., & Lesgold, A. (1977). Discourse comprehension and sources of individual differences. In M. Just and P. Carpenter (Eds.), Cognitive processes in comprehension (pp. 141-184). Hillsdale, NJ: Lawrence Erlbaum Associates.

Samuels, S. (1989). Training students how to understand what they read. Reading Psychology: An International Quarterly, 10, 1-17.

Samuels, S., Tennyson, R., Sax, L., Mulcahy, N., Schermer, N., & Hajovy, H. (1988). Adults' use of text structure in the recall of a "scientific article." Journal of Educational Research, 81, 171-174.

Schneider, W., & Shiffrin, R. (1977). Controlled and automatic human information processing: I. Detection, search, and attention. Psychological Review, 84, 1-66.

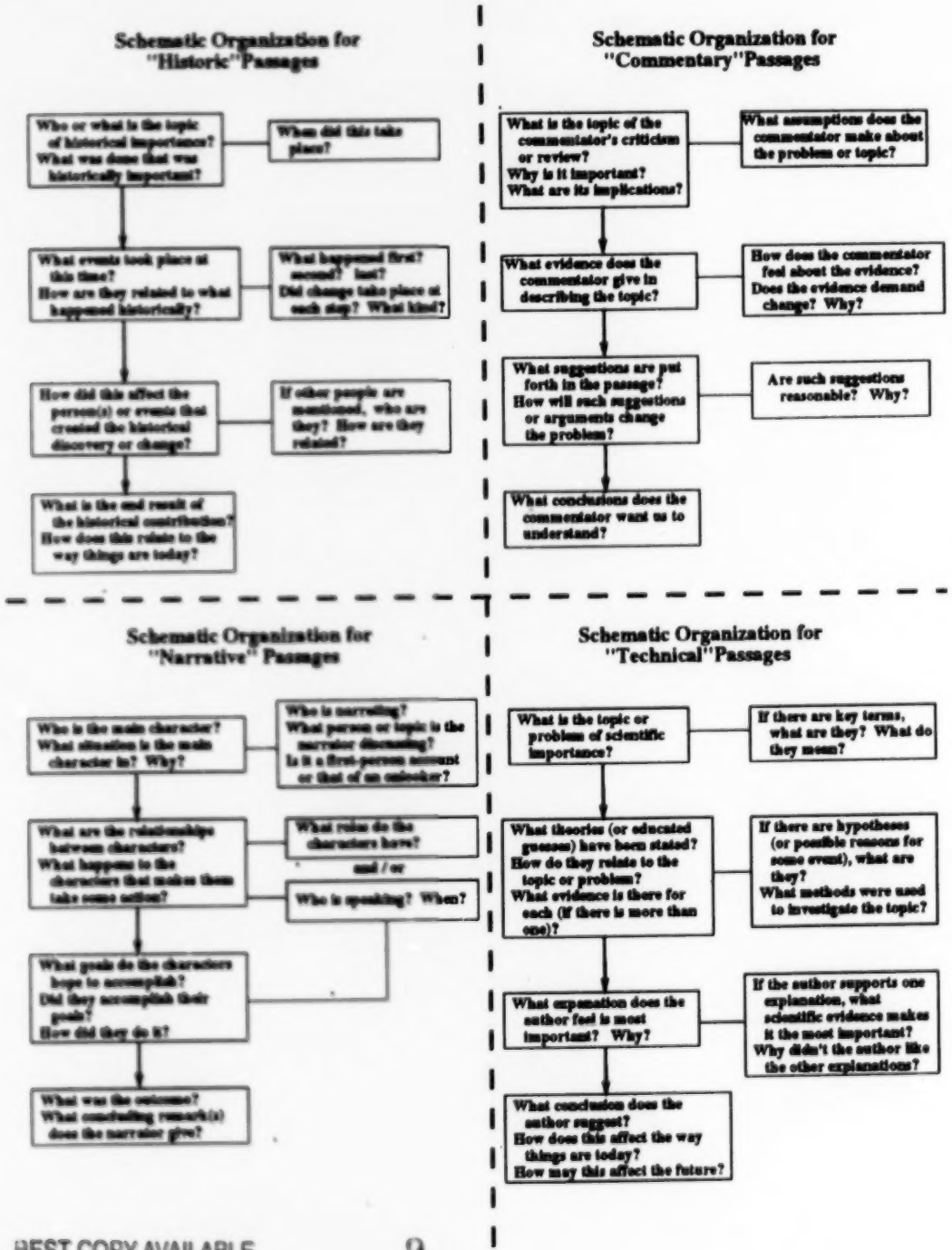
Shiffrin, R., & Schneider, W. (1977). Controlled and automatic human information processing: II. Perceptual learning, automatic attending, and a general theory. Psychological Review, 84, 127-190.

Simon, H. (1990). Invariants of human behavior. Annual Review of Psychology, 41, 1-19.

Singer, H. (1978). Active comprehension from answering to asking questions. Reading Teacher, 31, 901-908.

Wagoner, S. (1983). Comprehension monitoring: What it is and what we know about it. Reading Research Quarterly, 17, 328-346.

Figure 1.
Templates for schema instruction


Schematic Organization for "Historic" Passages
Who or what is the topic of historical importance? What was done that was historically important?
When did this take place?
What events took place at this time? How are they related to what happened historically?
What happened first? second? last? Did change take place at each step? What kind?
How did this affect the person(s) or events that created the historical discovery or change?
If other people are mentioned, who are they? How are they related?
What is the end result of the historical contribution? How does this relate to the way things are today?
Schematic Organization for "Commentary" Passages
What is the topic of the commentator's criticism or review? Why is it important? What are its implications?
What assumptions does the commentator make about the problem or topic?
What evidence does the commentator give in describing the topic?
How does the commentator feel about the evidence? Does the evidence demand change? Why?
What suggestions are put forth in the passage? How will such suggestions or arguments change the problem?
Are such suggestions reasonable? Why?
What conclusions does the commentator want us to understand?
Schematic Organization for "Narrative" Passages
Who is the main character? What situation is the main character in? Why?
Who is narrating? What person or topic is the narrator discussing? Is it a first-person account or that of an onlooker?
What are the relationships between characters? What happens to the characters that makes them take some action?
What roles do the characters have?
and / or
Who is speaking? When?
What goals do the characters hope to accomplish? Did they accomplish their goals? How did they do it?
What was the outcome? What concluding remark(s) does the narrator give?
Schematic Organization for "Technical" Passages
What is the topic or problem of scientific importance?
If there are key terms, what are they? What do they mean?
What theories (or educated guesses) have been stated? How do they relate to the topic or problem? What evidence is there for each (if there is more than one)?
If there are hypotheses (or possible reasons for some event), what are they? What methods were used to investigate the topic?
What explanation does the author feel is most important? Why?
If the author supports one explanation, what scientific evidence makes it the most important? Why didn't the author like the other explanations?
What conclusion does the author suggest? How does this affect the way things are today? How may this affect the future?

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